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# Combustible Contents in Buildings



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## BUILDING MATERIALS AND STRUCTURES REPORTS

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†Superseded by BMS144.

†Superseded by BMS116.

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# Combustible Contents in Buildings

S. H. Ingberg, John W. Dunham, and James P. Thompson



Building Materials and Structures Report 149

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## Foreword

The prevalent large building areas and heights require adequate fire resistance of structural supports and of subdividing constructions to restrict the spread of fire. The degree of fire resistance for the purpose is dependent on the severity of fires that can occur from burning of combustibles in contents and interior finish, floor, and trim. The present surveys were undertaken to obtain information on the amounts of combustibles associated with typical building occupancies. The data herein presented should be of assistance in constructing and equipping buildings to resist and restrict the fires that can occur within them.

A. V. ASTIN, *Director.*

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# Combustible Contents in Buildings

S. H. Ingberg,\* John W. Dunham,\*\* and James P. Thompson

Information is presented on the combustible contents, including the flooring and the interior finish and trim, found in buildings housing various classes of occupancy. The data given are based on surveys of specific buildings in which the weight and distribution of combustible contents were obtained area by area and floor by floor. The results indicate the range in the amounts of combustibles associated with different occupancies and show that, except for the areas used for filing and storage, the combustible load is uniformly light for residential buildings, schools, hospitals, and office buildings. The combustible load varies considerably in mercantile occupancies and even more so in industrial and storage buildings. In conjunction with fire severity tests, data from these surveys can be applied in developing requirements for minimum fire resistance of buildings.

## 1. Introduction

In 1939, the Subcommittee on Fire Resistance Classifications of the Central Housing Committee on Research, Design, and Construction had surveys made of residential buildings, schools, hospital buildings, and warehouses to determine the amounts of combustible contents associated with those occupancies. A similar survey of office buildings had previously been conducted by the National Bureau of Standards. Information based upon these surveys was published in 1942 [1].<sup>1</sup>

In 1947, the Office of Technical Services in the Department of Commerce sponsored a number of investigations to assist in the solution of various business and industrial problems. The investigation of the weights of combustible contents in mercantile, industrial, and storage occupancies was undertaken at that time to complement and extend the information previously presented in BMS92. The National Bureau of Standards assumed responsibility for the program and arranged to have the work done by the Public Buildings Administration (now the Public Buildings Service). Reports of the results of these surveys constitute the principal part of this publication.

Although not all of the occupancies defined by building codes were included in the surveys, those included were extensive enough to give a good indication of what can be expected. For example, the shoe or paint department in a department store could very well serve as the criterion for buildings containing either of these particular occupancies alone.

Evaluation of the resistance of buildings to the fires that occur in them requires not only a knowledge of the fire resistance of the construction, but an estimate of the potential severity of such fires. In tests conducted to obtain information on this subject [2], it was indicated that there is a fairly definite relation between the amount of combustible contents and the resulting fire severity expressed in hours as periods of exposure to the standard fire test [3].

To obtain an estimate of the probable fire severity in the various types of occupancies, the amounts of combustibles associated with these

occupancies must be known or estimated. These combustibles include movable property such as furniture and goods, and combustible trim, finish, and flooring material.

This report presents a large volume of data on combustible loads found in a number of typical occupancies. The data are factual and should be helpful in designing buildings to resist fires involving prospective amounts of combustible contents.

## 2. Basis and Method of Surveys

Only the weights of combustible contents, finished flooring, interior finish, and trim are included in the weight totals. No combustible structural elements are included because they are a part of the building itself and not of the contents.

In general, the amounts of combustibles were obtained by weighing combustible furniture, equipment, goods, and other combustible contents in sufficient quantity to enable the total weight of such material within each area to be computed. The weight of any combustible flooring material, showcases, partitions, door and window trim, and built-in fixtures that could not be weighed was estimated from the thickness and area. All of the weights were converted to equivalent weights of combustibles having a calorific value in the range of wood and paper. A table giving the calorific value of various compounds and materials can be found in references [2, 5, 6].

Where it was desired to segregate within close limits the weights for individual rooms, such as in residences, schools, hospitals, and office buildings, one-half of the weight of common doors, door frames, and wood sash was allocated to the respective rooms on each side of them. The total weight of the combustible contents of metal lockers, filing cabinets, etc., was included. No weight was included for possible escaping illuminating gas.

Small enclosures, such as closets, were found to contain concentrations of combustible materials considerably higher than the average for the rest of the unit. Considering the small area and the fact that wood closet doors are generally of the type that will burn through in a short time, the contents and area of closets were averaged with those of the adjoining hall or room.

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<sup>1</sup>Figures in brackets indicate the literature references at the end of this report.

### 3. Tabulated Results

The data presented in the tables show that the weights of combustible contents vary over a wide range among the different occupancies and, in some cases, for occupancies of the same type. These tables indicate the weight of combustibles per square foot of floor area associated with the occupancy surveyed and the area over which they were found. For some occupancies, summary tables give the percentage of the total area over which the weight of the combustibles within certain ranges were found and the largest single area within these ranges.

TABLE 1. Survey data for apartments and residences

(Data taken from BMS92)

Occupancy or use	Number of rooms surveyed	Average floor area	Average combustible contents			Total		
			Movable property	Floor	Exposed wood-work other than floor	Average	Maximum	Minimum
Basement.....	1	783	0.8	0.0	0.2	1.0	-----	-----
Bathroom.....	10	43	1.0	2.3	3.7	7.0	10.0	2.0
Bedroom (closets included).....	18	132	5.0	2.8	2.6	10.4	13.2	6.8
Dining room.....	3	164.5	3.2	2.0	2.0	7.2	7.8	6.5
Hallway.....	12	40.5	1.0	3.0	6.5	10.5	13.7	7.5
Kitchen.....	11	119	1.2	2.5	3.1	6.8	10.7	2.9
Library.....	1	146	10.6	-----	2.4	13.0	-----	-----
Living room.....	12	203	3.9	2.4	1.8	8.1	10.4	5.7
Storeroom (apartment house).....	6	727	6.4	0.5	0.3	7.2	10.0	2.4
Vestibule.....	1	22.5	2.2	3.0	4.4	9.6	-----	-----
Average for complete units.....	13	628.1	3.4	2.6	2.8	8.8	10.0	7.6
Summary for closets in residential buildings								
Closets:								
Clothes.....	28	8.8	5.1	2.7	11.6	19.4	30.2	10.2
Linen.....	9	4.8	11.7	3.0	21.4	36.1	49.3	26.2
Kitchen.....	1	5.0	4.0	3.0	23.2	39.2	-----	-----

TABLE 2. Survey data for hospital buildings, St. Elizabeths Hospital

(Data taken from BMS92)

Occupancy or use	Medical and surgical building							Average combustible contents	
	Number of rooms or units surveyed	Total floor area	Combustible contents					Neuropsychiatric continued-treatment hospital	Tuberculosis infirmary
			Movable property	Woodwork and floor covering <sup>1</sup>	Total				
					Average	Maximum	Minimum		
Administrative									
Administrative office .....	6	<i>ft</i> <sup>2</sup> 915	<i>lb/ft</i> <sup>2</sup> 6.3	<i>lb/ft</i> <sup>2</sup> 1.8	<i>lb/ft</i> <sup>2</sup> 8.1	<i>lb/ft</i> <sup>2</sup> 13.4	<i>lb/ft</i> <sup>2</sup> 2.4	<i>lb/ft</i> <sup>2</sup> 5.0	<i>lb/ft</i> <sup>2</sup> 3.5
Doctors' office .....	3	945	5.7	2.9	8.6	14.4	5.1	-----	2.9
Waiting rooms .....	3	495	1.4	1.8	3.2	4.1	2.1	3.2	1.4
Nurses' offices and rooms .....	13	1,728	3.1	1.9	5.0	12.5	3.1	-----	3.7
Nurses' training school .....	12	3,613	2.2	1.8	4.0	14.5	1.1	-----	-----
Nurses' infirmary .....	11	1,599	0.9	2.2	3.0	3.5	2.5	-----	-----
Library and conference .....	1	704	5.2	2.5	7.7	-----	-----	-----	-----

See footnote at end of table.

### 3.1. Apartments and Residences

The amounts of combustible contents found in apartments were so similar to those found in private residences that the two were grouped together. Table 1 gives the survey data for individual living and storage areas in a total of 13 apartments and residences, and the average combustible load for all the units taken as a whole. It is seen that the combustible load for a complete unit is relatively light, being not over 10 lb/ft<sup>2</sup>. Even in the storeroom areas this loading was not exceeded. To show the higher concentration of combustibles that exist in closets, table 1 also gives a summary for closets in residences, these concentrations being included with the adjoining rooms as given in the first part of the table.

### 3.2. Hospitals

St. Elizabeths Hospital, in Washington, D. C., was the only institutional-type occupancy included. Three buildings were surveyed, each housing the facilities necessary for a different type of treatment. Although St. Elizabeths is a psychiatric hospital, the results obtained may very well be typical of the general hospital occupancies covered, namely, neuropsychiatric continued treatment, tuberculosis infirmary, and medical and surgical.

Table 2 gives the results for the three buildings, and table 3 gives a summary of distribution for each building within given ranges of combustible contents. The average combustible loads for the various occupancies did not exceed 10 lb/ft<sup>2</sup>, except in the laundries, where it did not exceed 15 lb/ft<sup>2</sup>.

### 3.3. Schools

The maximum combustible contents in school buildings were found in storerooms and libraries, whereas other portions of the buildings had a relatively light combustible load. The pupils'



TABLE 2. Survey data for hospital buildings, St. Elizabeths Hospital—Continued

Occupancy or use	Medical and surgical building							Average combustible contents	
	Number of rooms or units surveyed	Total floor area	Combustible contents					Neuropsychiatric continued-treatment hospital	Tuberculosis infirmary
			Movable property	Woodwork and floor covering <sup>1</sup>	Total				
Average	Maximum	Minimum							
Service									
Corridors.....	26	15,103	-----	2.6	2.7	3.2	0.8	2.4	1.2
Heating and mechanical services.....	4	1,009	0.1	0.4	0.5	1.7	.3	1.0	0.5
Refrigeration.....	5	775	1.9	1.9	3.8	12.7	.0	-----	-----
Kitchen.....	7	3,259	0.2	0.3	0.5	4.7	.1	-----	1.7
Laundry.....	2	336	4.4	.6	5.0	12.4	3.8	13.1	-----
Janitors' closets and supplies.....	10	989	1.0	1.4	2.4	7.8	0.9	4.3	6.5
Stores.....	14	11,675	1.7	4.0	5.7	19.4	1.5	2.1	-----
Lockers and toilets.....	8	1,766	0.9	0.5	1.4	2.9	1.2	0.2	1.4
Clinical									
Surgery.....	13	4,307	0.7	1.1	1.8	10.6	0.2	-----	-----
Minor surgery and casts.....	2	390	2.1	1.1	3.2	3.8	2.2	-----	-----
Therapy and laboratories.....	4	978	2.8	1.6	4.4	7.3	2.5	-----	-----
Clinics.....	33	7,421	2.0	1.9	3.9	21.6	0.5	2.5	1.7
Dormitories.....	32	11,223	0.9	1.6	2.5	3.6	1.7	1.5	2.8
Rooms, single.....	28	3,511	.8	1.5	2.3	3.2	1.8	2.1	3.7
Rooms, disturbed patients'.....	8	1,016	.4	2.5	2.9	3.2	2.2	-----	3.7
Day and waiting rooms.....	3	720	.8	2.4	3.2	3.8	2.5	-----	-----
Porches, patients'.....	6	3,566	.9	0.4	1.3	2.3	0.9	0.8	1.3
Sterilizers and clothing stores.....	4	545	1.4	4.0	5.4	5.8	5.0	.5	4.0
Pharmacy, dispensary and stores.....	5	1,172	5.8	1.9	7.7	11.5	6.8	-----	-----
Diet kitchens and patients' dining rooms.....	9	1,755	1.2	2.4	3.6	5.2	2.7	-----	-----
Lavatories, etc.....	22	2,304	0.5	1.4	1.9	5.4	0.3	.1	0.5

<sup>1</sup> Combustible floor finish where present was  $\frac{3}{4}$ -in.-thick linoleum, assumed to give equivalent in combustible material of 1 lb/ft<sup>2</sup>.

TABLE 3. Distribution of combustible contents, St. Elizabeths Hospital

Combustible contents for usable floor area	Medical and surgical building	Continued treatment building	Tuberculosis infirmary
lb/ft <sup>2</sup>	Percent	Percent	Percent
0 to 4.9.....	82.1	91.0	93.2
5 to 9.9.....	15.4	7.6	0.3
10 to 14.9.....	1.6	0.7	1.8
15 to 19.9.....	0.5	-----	4.4
20 or more.....	.4	.7	0.3
Usable floor area.....ft <sup>2</sup> ..	83,819	36,907	23,054

TABLE 4. Survey data for rooms in six school buildings in the Washington, D. C., area

(Data taken from BMS92)

Occupancy	Average floor area	Average combustible contents				
		Mov-able prop-erty	Floor	Ex-posed wood-work other than floor	Total	
	ft <sup>2</sup>	lb/ft <sup>2</sup>	lb/ft <sup>2</sup>	lb/ft <sup>2</sup>	lb/ft <sup>2</sup>	
Auditorium, gymnasium, and lunchroom.....	5,193	0.7	4.2	1.5	6.4	
Typical classroom.....	752	2.3	2.4	2.3	7.0	
Laboratories: biology, chemistry, physics, food, and clothing.....	1,038	4.5	2.1	1.5	8.1	
Special classrooms: art, bookkeeping, mechanical drawing, typing, physics lecture, wood-working shop, library reading room.....	1,335	6.2	2.3	1.9	10.4	
Offices: home economics, publications, teachers....	342	8.0	3.1	3.1	14.2	
Library stackroom.....	264	28.4	2.1	5.4	35.9	
Office and files.....	276	36.3	2.6	0.1	39.0	
Storerooms:						
Paint.....	184	4.0	2.6	13.1	19.7	
Janitor.....	353	35.9	0.9	1.5	38.3	
Lumber.....	480	43.7	1.3	0.7	45.7	
Paper.....	425	97.5	0.0	.7	98.2	
Textbook.....	590	172.3	.7	.6	173.6	

wearing apparel and the contents of the desks were not included in the survey.

Table 4 gives a summary of the combustible contents for 4 high schools and 2 elementary schools in Washington, D. C., and vicinity. Except where heavy filing cases, library stacks, and storage of textbooks or materials were involved, the combustible load was found to be less than 15 lb/ft<sup>2</sup>.

From table 5 it is seen that less than 5 percent of the entire floor area of each building contained combustible loads in excess of 15 lb/ft<sup>2</sup>. Usually the rooms or areas with heavy combustible loads were in the basement, ground, or first floors. One

TABLE 5. Data for six schools in the Washington, D. C., area showing the percentage of usable floor area having combustible contents within certain limits

Range of combustible contents lb/ft <sup>2</sup>	Elementary schools		High schools			
	Per- cent	Per- cent	Per- cent	Per- cent	Per- cent	Percent
0 to 4.9	38.2	50.8	54.6	50.3	66.4	32.6
5.0 to 9.9	58.5	47.1	34.4	31.0	25.4	64.1
10.0 to 14.9	2.5	2.1	6.2	16.2	5.3	3.0
15.0 to 24.9	---	---	1.0	0.3	0.2	---
25.0 to 34.9 (general storage)	---	---	2.3	1.0	2.0	---
35.0 to 49.9 (general storage)	---	---	1.2	0.6	0.2	---
50.0 to 74.5 (wood or paper storage)	.8	---	0.2	---	---	---
75.0 to 99.9 (paper storage)	---	---	---	---	.3	---
103.3 (paper storage)	---	---	.1	---	---	---
167.6 (textbook storage)	---	---	---	.6	---	---
255.7 (textbook storage)	---	---	---	---	---	.3
288 (textbook storage)	---	---	---	---	.2	---
Number of floors	2	3	4	4	5	2
Usable floor area	31,309	40,098	130,973	125,790	254,619	24,177

a Exclusive of basement, which contains boiler room only.

b Exclusive of temporary wooden corridor.

c Excludes attic and basement, which latter contains boiler room only.

small textbook-storage room and a large library stackroom were found on the second floor in these buildings. Janitors' and general storerooms with average combustible loads near 25 lb/ft<sup>2</sup> were found on upper as well as lower floors in one or more of these buildings. Their individual and aggregate areas, however, were relatively small.

### 3.4. Mercantile Establishments

The department store is unique in that there are contained within its various departments practically all of the characteristics common to single mercantile occupancies handling similar merchandise. As a result, these data have a wide scope of usefulness.

The New York, N. Y., department store selected was of such size that a complete survey was not feasible; therefore, the survey was limited to the selling areas and small storage areas frequented by the clerks, but did not include workshops, packing rooms, tube rooms, offices, etc., associated with the selling areas. The tenth through the twentieth floors, which were used for storage and offices, were also omitted. The combustible load per square foot for a whole department was determined by weighing the combustible contents in a representative area of the department.

The second-floor plan of a department store in Washington, D. C., figure 1,<sup>2</sup> shows a typical department arrangement and the combustible loads that were found to exist at the time of the survey. Although stores of this type are continually making minor changes in arrangement, the floor plan shown indicates the combustible-load differential of the various departments, the higher accumu-

lation of combustibles in storage areas as compared to sales areas, and the ready manner in which storage areas can be established anywhere throughout the area. The load is assumed to be uniformly distributed over each area, including the area of aisle spaces.

Tables 6a and 6b give a summary of combustible loads by floors. For 4 floors of the New York City store the average was below 10 lb/ft<sup>2</sup>, and for the 6 others the highest average for any 1 floor was 13.4 lb/ft<sup>2</sup>. For the Washington, D. C., store the average was not over 10 lb/ft<sup>2</sup> for 6 floors, and the highest individual average for the 2 other floors was 12.6 lb/ft<sup>2</sup>.

TABLE 6a. Survey data for a department store in New York City

Department	Area	Combustible contents		
		Mov- able prop- erty and display trim	Floor	Total
Basement floor				
Kitchen furniture.....	ft <sup>2</sup> 4,353	lb/ft <sup>2</sup> 0.9	----	0.9
Bathroom supplies.....	3,354	6.3	----	6.3
Major appliances: Stoves, vac- uum cleaners, sinks, etc.....	3,415	4.0	----	4.0
Refrigeration units.....	2,270	2.8	----	2.8
Household utensils.....	22,920	7.3	----	7.3
Automobile accessories.....	1,300	8.7	----	8.7
Hardware.....	6,153	10.3	----	10.3
Paints.....	966	46.6	----	46.6
Tea room.....	4,062	2.4	----	2.4
Soda fountain.....	1,358	2.4	----	2.4
Home center.....	913	2.4	----	2.4
Total.....	51,064	----	----	----
Average.....	-----	6.8	----	6.8
First floor				
Liquor sales.....	2,415	11.1	----	11.1
Men's work clothes.....	2,490	10.6	----	10.6
Men's furnishings: Shirts, etc.....	15,712	14.3	----	14.3
Tobacco.....	1,113	15.6	----	15.6
Books.....	8,337	15.0	----	15.0
Drugs.....	8,916	9.5	----	9.5
Stationery.....	5,158	8.8	0.6	9.4
Candy.....	1,298	8.9	2.0	10.9
Cosmetics.....	4,565	7.0	2.0	9.0
Notions, gloves, and handker- chiefs.....	15,372	6.9	2.0	8.9
Jewelry.....	2,216	8.5	----	8.5
Costume jewelry.....	3,122	6.9	2.0	8.9
Ladies' handbags.....	2,873	9.0	2.0	11.0
Umbrellas.....	400	14.8	----	14.8
Silverware.....	3,681	7.4	----	7.4
Temporary bargain counter.....	9,181	6.7	----	6.7
Total.....	86,849	----	----	----
Average.....	-----	9.9	0.7	10.6
Second floor				
Women's bats.....	18,378	6.2	4.8	11.0
Negligee and lingerie.....	20,673	6.6	5.2	11.8
Corsets and girdles.....	5,932	10.4	5.2	15.6
Men's suits.....	17,733	8.0	----	8.0
Storage, men's suits.....	1,668	17.0	----	17.0
Men's shoes.....	3,777	7.1	----	7.1
Storage, men's shoes.....	1,856	22.3	----	22.3
Men's furnishings.....	9,213	14.3	----	14.3
Women's dresses.....	14,056	5.2	5.2	10.4
Total.....	93,286	----	----	----
Average.....	-----	8.1	3.2	11.3

<sup>2</sup> Figures are given at the end of this report.



TABLE 6a. Survey data for a department store in New York City—Continued

Department	Area	Combustible contents		
		Mov- able prop- erty and display trim	Floor	Total
Third floor				
Fur storage, cleaning, and repair- ing.....	ft <sup>2</sup> 6,415	lb/ft <sup>2</sup> 7.8	lb/ft <sup>2</sup> -----	lb/ft <sup>2</sup> 7.8
Women's dresses.....	22,600	5.2	-----	5.2
Budget furs.....	4,917	2.6	-----	2.6
Women's suits and coats.....	49,382	5.6	5.2	10.8
Better furs.....	5,451	6.2	5.2	11.4
Women's beach wear.....	10,811	9.0	5.2	14.2
Total.....	99,576	-----	-----	-----
Average.....	-----	5.9	3.4	9.3
Fourth floor				
Children's shoes.....	9,722	5.1	5.2	10.3
Storage, children's shoes.....	2,968	20.5	5.2	25.7
Children's hose.....	820	11.1	5.2	16.3
Girls' clothing.....	12,083	9.3	5.2	14.5
Children's clothing.....	6,530	11.3	5.2	16.5
Girls' dresses.....	9,716	7.1	5.2	12.3
Infants' furnishings.....	12,127	5.6	5.2	10.8
Temporary bargain counter.....	766	6.7	5.2	11.9
Total.....	54,732	-----	-----	-----
Average.....	-----	8.2	5.2	13.4
Fifth floor				
Boys' camp equipment.....	4,080	9.3	-----	9.3
Boys' clothing.....	14,323	6.8	-----	6.8
Toys.....	12,089	3.2	-----	3.2
Playground equipment.....	5,054	2.4	5.2	7.6
Sporting goods.....	10,707	5.2	5.2	10.4
Radios and phonographs.....	4,299	4.7	5.2	9.9
Crosley automobiles.....	720	2.4	5.2	7.6
Airplanes.....	500	2.4	5.2	7.6
Pianos.....	3,280	6.1	5.2	11.3
Commercial stationery.....	1,967	8.3	5.2	13.5
Cameras, etc.....	3,194	9.1	5.2	14.3
Art supplies.....	2,203	13.3	5.2	18.5
Phonograph records.....	6,400	29.2	5.2	34.4
Toys.....	6,904	3.2	5.2	8.4
Total.....	75,720	-----	-----	-----
Average.....	-----	7.5	3.1	10.6
Sixth floor				
Women's shoes.....	21,358	3.5	-----	3.5
Storage, women's shoes.....	12,085	9.8	-----	9.8
Towels.....	6,882	9.4	5.2	14.6
Blankets.....	6,811	9.6	5.2	14.8
Sheets and linens.....	17,379	15.1	5.2	20.3
Notions.....	2,238	8.2	5.2	13.4
Patterns.....	2,525	13.0	5.2	18.2
Yard goods.....	26,904	11.3	5.2	16.5
Total.....	96,182	-----	-----	-----
Average.....	-----	9.8	3.4	13.2
Seventh floor				
Linoleum.....	3,070	5.2	-----	5.2
Rugs.....	27,651	8.0	-----	8.0
Candles.....	200	19.6	5.2	24.8
Lamps and shades.....	7,868	6.0	5.2	11.2
Curtains.....	14,430	3.4	5.2	8.6
Closet shop.....	8,109	8.5	5.2	13.7
Wallpaper.....	1,190	8.4	5.2	13.6
Assorted yard goods.....	23,303	11.3	5.2	16.5
Total.....	85,821	-----	-----	-----
Average.....	-----	8.0	3.3	11.3

TABLE 6a. Survey data for a department store in New York City—Continued

Department	Area	Combustible contents		
		Mov- able prop- erty and display trim	Floor	Total
Eighth floor				
Food.....	<i>ft</i> <sup>2</sup> 10, 190	<i>lb/ft</i> <sup>2</sup> 7. 0	<i>lb/ft</i> <sup>2</sup> 5. 2	<i>lb/ft</i> <sup>2</sup> 12. 2
Glassware.....	9, 438	5. 2	-----	5. 2
Chinaware.....	19, 244	8. 3	-----	8. 3
Pictures and frames.....	7, 253	4. 6	-----	4. 6
Luggage.....	8, 149	5. 2	-----	5. 2
Total.....	54, 274	-----	-----	-----
Average.....	-----	6. 5	1. 0	7. 5
Ninth floor				
Bedroom furniture.....	24, 929	4. 0	5. 2	9. 2
Dining room and occasional fur- niture.....	55, 847	3. 4	5. 2	8. 6
Modern furniture.....	12, 513	9. 3	5. 2	14. 5
Total.....	93, 289	-----	-----	-----
Average.....	-----	4. 4	5. 2	9. 6

TABLE 6b. Survey data for a department store in Wash-  
ington, D. C.

Department	Area	Combustible contents		
		Mov- able prop- erty and display trim	Floor	Total
First floor				
Dry cleaning counter.....	ft <sup>2</sup> 320	lb/ft <sup>2</sup> 9.2	lb/ft <sup>2</sup> -----	lb/ft <sup>2</sup> 9.2
Books.....	3,450	16.6	-----	16.6
Candy.....	1,600	11.9	-----	11.9
Notions.....	9,750	10.1	-----	10.1
Umbrellas.....	350	20.0	-----	20.0
Service.....	150	11.0	-----	11.0
Cosmetics.....	6,350	5.6	-----	5.6
Handbags and leather goods.....	2,800	7.3	-----	7.3
Hat bar.....	300	11.0	-----	11.0
Stationery.....	5,500	12.1	-----	12.1
Costume jewelry.....	2,900	6.1	-----	6.1
Jewelry.....	3,350	7.6	-----	7.6
Total.....	36,820	-----	-----	-----
Average.....	-----	9.6	-----	9.6
Second floor				
Dry goods, patterns, and art goods.....	8,752	9.9	-----	9.9
Ladies' shoe stockroom.....	2,000	32.8	-----	32.8
Children's shoe stockroom.....	955	28.1	-----	28.1
Shoe sale space.....	3,944	3.1	-----	3.1
Storage, men's hats, shoes, to- bacco, etc.....	809	31.7	-----	31.7
Men's clothing.....	16,227	12.0	-----	12.0
Total.....	32,687	-----	-----	-----
Average.....	-----	12.6	-----	12.6

TABLE 6b. *Survey data for a department store in Washington, D. C.—Continued*

Department	Area	Combustible contents		
		Mov- able prop- erty and display trim	Floor	Total
Third floor				
Women's hats.....	4,300	6.8	5.2	12.0
Lingerie and dresses.....	5,700	9.0	5.2	14.2
Ladies' ready-to-wear.....	16,350	5.0	---	5.0
Ladies' gowns and furs.....	18,500	5.3	5.2	10.5
Total.....	44,850	---	---	---
Average.....	---	5.8	3.3	9.1
Fourth floor				
Boy's clothing.....	3,830	13.6	5.2	18.8
Infant and juvenile clothing.....	11,934	8.05	---	8.05
Camera and radio.....	3,958	5.9	---	5.9
Music.....	2,870	24.3	4.0	28.3
Junior misses.....	14,022	4.9	---	4.9
Total.....	36,614	---	---	---
Average.....	---	8.5	0.8	9.3
Fifth floor				
Gift shop.....	2,800	9.7	---	9.7
China and glass.....	11,400	6.2	---	6.2
Linen and towels.....	5,500	9.5	---	9.5
Bedroom furniture.....	15,800	5.6	5.2	10.8
Bedding.....	4,350	10.1	---	10.1
Carpenter and paint shop.....	2,600	20.8	5.2	26.0
China and glass storage.....	440	11.4	---	11.4
General wrapping.....	1,550	9.7	3.9	13.6
Total.....	44,440	---	---	---
Average.....	---	8.0	2.3	10.3
Sixth floor				
Furniture display room.....	8,145	5.8	1.4	7.2
Employees' cafeteria.....	1,496	4.8	5.2	10.0
Rug department.....	10,925	10.2	5.2	15.4
Foyer.....	780	3.1	5.2	8.3
Storage and shipping room for rug and linoleum.....	822	22.8	5.2	28.0
Furniture.....	14,200	4.0	1.7	5.7
Miscellaneous furniture and of- fice.....	2,468	7.7	---	7.7
Interior decorating.....	1,420	16.3	5.2	21.5
Total.....	40,256	---	---	---
Average.....	---	7.0	3.0	10.0
Seventh floor				
Luggage.....	4,250	5.2	---	5.2
Pictures.....	2,100	11.9	---	11.9
Lamps.....	4,100	7.8	---	7.8
Draperies.....	9,000	7.5	---	7.5
Drapery storage No. 1.....	960	25.0	---	25.0
Drapery storage No. 2.....	550	44.4	---	44.4
Auditorium.....	800	5.2	---	5.2
Offices.....	4,000	6.9	---	6.9
Bakery sales.....	500	8.6	---	8.6
Waiting room at tea room.....	1,200	1.5	---	1.5
Fountain room and fountain.....	2,900	4.8	---	4.8
Tea room.....	8,300	4.0	---	4.0
Linen storage (tea room).....	380	20.6	---	20.6
Total.....	39,040	---	---	---
Average.....	---	7.4	---	7.4

TABLE 6b. *Survey data for a department store in Washington, D. C.—Continued*

Department	Area	Combustible contents		
		Mov- able prop- erty and display trim	Floor	Total
Eighth floor				
	ft <sup>2</sup>	lb/ft <sup>2</sup>	lb/ft <sup>2</sup>	lb/ft <sup>2</sup>
Paint.....	1,749	35.2	5.2	40.4
Household goods.....	7,781	3.7	5.2	8.9
Groceries.....	3,500	1.5	----	1.5
Cold storage for groceries.....	400	3.9	----	3.9
Refrigerators, etc.....	2,307	2.3	----	2.3
Electrical.....	1,400	9.1	----	9.1
Bathroom fittings.....	3,205	8.5	5.2	13.7
Cafeteria.....	3,834	2.8	5.2	8.0
Central wrapping.....	2,556	8.0	5.2	13.2
Bakery.....	3,210	3.0	----	3.0
Paper storage.....	360	25.0	5.2	30.2
Fur fitting.....	2,000	3.1	5.2	8.3
Office.....	7,230	5.3	1.1	6.4
Total.....	39,532	----	----	----
Average.....	----	6.2	2.8	9.0

TABLE 6c. *Summary of combustible loads in department stores by occupancies*

(Combustible weight of flooring and covering not included)

Range	Occupancies in one or both department stores
0 to 4.9.....	Kitchen equipment, furniture, fur, shoe, dress, curtain, radio, phonograph, toys, pictures, frames, and grocery sales; foyer, tearoom, cafeteria, soda fountain, and waiting room.
5.0 to 9.9.....	Household utensils, automobile accessories, drugs, stationery, candy, cosmetics, notions, jewelry, clothing, fur, shoe, sporting goods, piano, camera, towels, blankets, linoleum, rug, lamp, wallpaper, grocery, glass, chinaware, luggage, furniture, dry goods, and hat sales; shoe storage; dry cleaning counter; auditorium and offices.
10.0 to 14.9.....	Hardware, liquor, clothing, art supplies, dry goods, candy, notions, hat, stationery, rug, and picture sales.
15.0 to 19.9.....	Book, tobacco, umbrella, clothing, linen, candle and interior decorating sales; clothing storage.
20.0 to 29.9.....	Phonograph records and music sheet and book sales; shoe, rug, linoleum, paper, and drapery storage; carpenter and paint shop.
30.0 to 39.9.....	Paint sales; clothing and shoe storage.
40 to 46.6.....	Paint sales; drapery storage.

TABLE 6d. *Percentage of department-store floor area having combustible contents within certain limits*

Range of combustible contents	Washington (Total floor area, 314,239 ft <sup>2</sup> )		New York (Total floor area, 790,793 ft <sup>2</sup> )	
	Part of total floor area	Largest single area within range	Part of total floor area	Largest single area within range
lb/ft <sup>2</sup>	Percent	ft <sup>2</sup>	Percent	ft <sup>2</sup>
0.0 to 4.9.....	12.6	14,022	7.8	21,358
5.0 to 9.9.....	46.7	16,350	43.1	55,875
10.0 to 14.9.....	29.9	18,500	35.3	49,382
15.0 to 19.9.....	5.8	10,925	10.0	26,904
20.0 to 29.9.....	3.4	2,870	2.8	17,379
30.0 to 39.9.....	0.9	2,000	0.8	6,400
40 and over.....	.7	1,749	.2	966



Table 6c gives a summary of the combustible loads contributed by movable property and display trim in department stores as related to the type of goods sold or stored, based on tables 6a and 6b. The majority of the sales areas had combustible loads of 10 lb/ft<sup>2</sup> or less, some had loads between 10 and 20 lb/ft<sup>2</sup>, and a few, including sales areas for books and for paints, had higher loads. Storage of clothing, rugs, shoes, paper, and drapery material gave combustible loads in the range from 15 to 46.6 lb/ft<sup>2</sup>.

The percentage of department-store areas having combustible loads between given limits is shown in table 6d. It is seen that from 50 to 60 percent of the floor area had combustible loads not over 10 lb/ft<sup>2</sup>, from 30 to 35 percent had between 10 and 15 lb/ft<sup>2</sup>, 10 percent had between 15 and 20 lb/ft<sup>2</sup>, and no more than 5 percent of the area had more than 20 lb/ft<sup>2</sup>.

### 3.5. Manufacturing Establishments

The surveys of manufacturing occupancies included 2 furniture factories, 2 mattress factories, a women's clothing factory, and a men's clothing factory. Where more than one area is used for the same purpose, separate entries are made in the tables for each area.

#### a. Furniture Factories

All of the buildings or portions of buildings used in the production, shipping, storage, and display of furniture were surveyed. Outside lumber storage and service buildings were not included.

The Gettysburg, Pa., factory surveyed had 20 buildings, of 1 story, 1 story and basement, or 2 stories, nearly all contiguous with structural separations. The floor and roof constructions of all buildings were of wood, but all except buildings 11 and 12 had masonry exterior and interior walls. Figure 2 shows the building layout. In determining the combustible content of the first floor of the shipping and storage building, it was assumed that the contents of a car of furniture loaded just prior to the survey were in the shipping-room area.

The Grand Rapids, Mich., factory was housed in 18 buildings, all but 3 of which were contiguous. Most of them had 3 or 4 stories, with or without basements. They were largely of heavy-timber construction. A 3-story building used in part for exhibition purposes was of reinforced-concrete construction.

Tables 7a and 7b give the survey data for the two furniture factories, and table 7c gives the percentage of the total area with combustibles within a given range and the largest single area over which combustibles within these ranges were found.

In the lower range of combustible contents, there was a marked difference found for the two plants. For the Gettysburg plant, only 1½ percent of the floor area had combustibles in an

TABLE 7a. Survey data for furniture factory in Gettysburg, Pa.

See figure 2 for building layout.

Building	Area	Occupancy or use	Floor area	Combustible contents		
				Other than floor	Floor	Total
			ft <sup>2</sup> (i)	lb/ft <sup>2</sup> (i)	lb/ft <sup>2</sup> (i)	lb/ft <sup>2</sup> (i)
1		Boiler house	5,450	15.8	5.2	21.0
	a	Millwork	3,100	12.0	5.2	17.2
2	b	do.	760	22.1	5.2	27.3
	c	do.	1,030	8.0	5.2	13.2
	d	Glue room	130	4.5	5.2	9.7
	e	Office	130	9.8	5.2	15.0
	f	Pattern room	3,900	6.3	5.2	11.5
3		Staining	10,200	7.9	5.2	13.1
4		Spraying	5,920	7.1	5.2	12.3
5		Finishing	216	99.3	5.2	104.5
	a	Paint sbop				
6		Dry kilns	5,660	68.9	--	68.9
		Millwork	5,600	15.6	--	15.6
7		Basement	5,600	13.3	5.2	18.5
	First floor	do.	598	95.9	5.2	101.1
	a	Storage a				
8		Basement	7,450	48.7	--	48.7
	First floor	Cabinet work and storage b				
		Cabinet manufacture	7,100	13.2	5.2	18.4
9		do.	4,650	15.9	5.2	21.1
10		Basement	2,800	62.9	--	62.9
	First floor	Storage c	2,750	6.5	5.2	11.7
		Spraying				
11		Storage d	2,750	30.8	5.2	36.0
12		do e	2,360	83.0	--	83.0
13		Varnish vault	600	16.5	--	16.5
14		Lumber shed	(i)	(i)	(i)	(i)
15		Pump house				
16		Rubbing and polishing	6,200	5.1	5.2	10.3
17		Storage e	5,850	12.0	5.2	17.2
18		First floor	7,400	15.6	5.2	20.8
	Second floor	do f	7,400	12.0	5.2	17.2
19		Finishing	1,750	4.7	5.2	9.9
20		Shipping and storage g	9,675	11.4	5.2	16.6
	Second floor	Storage h	10,625	13.6	5.2	18.8
Total			127,654	--	--	--
Average				19.3	4.6	23.9

a Lumber being transferred from dry kilns.

b Plywood panels loaded on trucks.

c Plywood (3-ply).

d Veneer and packing material.

e Furniture.

f Furniture and packing material.

g Furniture (some crated ready to ship).

h Furniture (chairs).

i Not surveyed.

amount less than 10 lb/ft<sup>2</sup>; whereas for Grand Rapids, over one-half of the area was thus relatively lightly loaded. This was due in part to a somewhat lighter wood flooring in the Grand Rapids plant.

A generally lighter combustible loading for the latter plant is also indicated by a relatively small percentage of the floor area having combustible loads in the higher ranges. Eight percent of the area for the Grand Rapids plant and about 17 percent of that at Gettysburg had combustibles of 30 lb/ft<sup>2</sup> or over. These areas were confined to spaces used for storage, air and kiln drying, and paint and lacquer shops and vaults.

#### b. Mattress Factories

Two establishments manufacturing mattresses were surveyed, one in Atlanta, Ga., and the other



TABLE 7b. *Survey data for furniture factory in Grand Rapids, Mich.*

Occupancy or use	Number of units surveyed	Total floor area	Average combustible contents			*Maximum	*Minimum
			Other than floor	Floor	Total		
		ft <sup>2</sup>	lb/ft <sup>2</sup>	lb/ft <sup>2</sup>	lb/ft <sup>2</sup>	lb/ft <sup>2</sup>	lb/ft <sup>2</sup>
Photo studio.....	1	4,970	1.8	0.0	1.8	--	--
Exhibition.....	1	9,940	3.4	.0	3.4	--	--
Trucking area.....	1	2,670	0.0	4.0	4.0	--	--
Smoking room.....	1	720	5.7	0.0	5.7	--	--
Kitchen.....	1	750	7.1	.0	7.1	--	--
Cabinet and assembly work.....	7	71,365	3.4	4.0	7.4	14.2	6.4
Shipment make-up.....	4	34,900	3.9	4.0	7.9	10.7	7.0
Finishing.....	8	80,320	4.7	4.0	8.7	13.0	5.9
Maintenance shop.....	3	19,230	5.8	5.2	11.0	13.2	5.5
Office and sales.....	2	1,404	7.3	4.0	11.3	11.6	9.5
Banquet and bar.....	1	1,900	11.4	0.0	11.4	--	--
Storage for shipment.....	2	8,380	14.3	.0	14.3	30.0	8.0
Storage.....	11	80,575	15.1	2.1	17.2	30.1	2.5
Sawing.....	2	12,800	12.6	4.8	17.4	23.0	9.3
Drafting.....	1	860	13.9	4.0	17.9	--	--
Woodworking.....	7	53,186	13.9	4.1	18.0	28.5	11.3
Glue room.....	2	15,600	14.3	5.0	19.3	21.7	16.9
Leather room.....	1	500	27.3	0.0	27.3	--	--
Lacquer vault.....	2	1,660	53.3	.0	53.3	73.0	33.6
Air-drying building.....	1	10,200	59.4	4.0	63.4	--	--
Dry kilns.....	1	8,100	97.2	0.0	97.2	--	--
Vencer storage.....	1	2,100	117.3	.0	117.3	--	--

\* No entry indicates that only one area was used for that occupancy.

TABLE 7c. *Percentage of furniture-factory floor having combustible contents within certain limits*

Range of combustible contents	Gettysburg, Pa. (Total floor area, 127,654 ft <sup>2</sup> )		Grand Rapids, Mich. (Total floor area, 421,164 ft <sup>2</sup> )	
	Part of total floor area	Largest single area within range	Part of total floor area	Largest single area within range
lb/ft <sup>2</sup>	Percent	ft <sup>2</sup>	Percent	ft <sup>2</sup>
0.0 to 4.9.....	-----	-----	6.4	9,940
5.0 to 9.9.....	1.5	1,750	48.3	15,300
10.0 to 14.9.....	23.5	10,200	14.3	10,932
15.0 to 19.9.....	43.6	10,625	10.7	11,500
20.0 to 29.9.....	14.3	7,400	12.3	15,400
30.0 to 39.9.....	2.2	2,750	3.0	9,280
40.0 to 65.0.....	8.0	7,450	2.4	10,200
Over 65.0.....	6.9	5,660	2.6	8,100

in Chicago, Ill. The Atlanta plant had 7 buildings of 1 or 2 stories. One of these, used for the assembly and storage of springs, was of reinforced-concrete construction and the others were of masonry-wall, wood-joist, or all-metal construction. Temporary wood partitions and wood-plank flooring covering parts of the area are included in the combustible contents.

The Chicago plant was housed in what was structurally one building with masonry exterior and subdividing walls, and interior wood or steel construction. The height for the different parts of the building ranged from 1 to 5 stories, with a basement under all but the 1- and 2-story portions. There was maple flooring in all except basement, shop, and garnetting areas.

Table 8c gives a summary of combustibles within given ranges of concentration and the

largest single area over which they were found, based upon the survey data given in tables 8a and 8b.

TABLE 8a. *Survey data for mattress factory in Atlanta, Ga.*

Occupancy or use	Area	Combustible contents		
		Mov- able prop- erty and trim	Floor	Total
Second floor, building 1				
	ft <sup>2</sup>	lb/ft <sup>2</sup>	lb/ft <sup>2</sup>	lb/ft <sup>2</sup>
Spring assembly.....	805	1.5	0.0	1.5
Spring storage.....	900	0.0	.0	0.0
Spring assembly.....	1,124	1.1	.0	1.1
Do.....	453	3.5	.0	3.5
Lockers.....	207	6.2	.0	6.2
Total.....	3,489	---	---	---
Average.....	---	1.5	0.0	1.5
Second floor, building 2				
Temporary storage.....	1,743	5.4	3.9	9.3
Cotton felt mattress.....	1,312	2.4	3.9	6.3
Mattress stapling.....	635	2.7	3.9	6.6
Mattress make-up.....	635	1.7	3.9	5.6
Mattress tape edging.....	942	3.9	3.9	7.8
Mattress button tufting.....	1,243	2.9	3.9	6.8
Mattress reginning.....	440	18.0	3.9	21.9
Spring receiving.....	472	8.3	3.9	12.2
Stapling.....	472	5.2	3.9	9.1
Cotton felt mattress.....	864	4.9	3.9	8.8
Cotton tufting.....	1,115	2.3	3.9	6.2
Roll edging.....	950	7.7	3.9	11.6
Temporarily unused.....	800	0.0	3.9	3.9
Total.....	11,623	---	---	---
Average.....	---	4.1	3.9	8.0
Second floor, building 2A				
Box spring assembly.....	816	11.1	3.9	15.0
Box spring make-up.....	900	9.4	4.7	14.1
Do.....	648	2.5	3.9	6.4
Box spring storage.....	1,263	2.9	3.9	6.8
Quilting tops.....	1,450	3.3	4.4	7.7
Temporary storage.....	990	9.6	3.9	13.5
Packaging.....	2,115	4.2	5.4	9.6
Total.....	8,182	---	---	---
Average.....	---	5.7	4.4	10.1
Second floor, building 2B				
Stock room.....	1,556	56.3	3.9	60.2
Sewing room.....	2,160	2.1	3.9	6.0
Total.....	3,716	---	---	---
Average.....	---	24.8	3.9	28.7
First floor, building 3				
Cotton cleaner, picker.....	561	4.2	0.0	4.2
Cotton mixers.....	1,080	0.6	.0	0.6
Cotton stores.....	825	12.0	.0	12.0
Cotton batting, etc., stores.....	6,170	15.4	.0	15.4
Total.....	8,636	---	---	---
Average.....	---	12.5	0.0	12.5
Second floor, building 3				
Garnetting.....	1,750	2.5	5.2	7.7
Do.....	2,816	2.6	5.2	7.8
Do.....	1,540	1.3	5.2	6.5
Fales.....	1,853	3.1	5.2	8.3
Total.....	7,959	---	---	---
Average.....	---	2.5	5.2	7.7

TABLE 8a. *Survey data for mattress factory in Atlanta, Ga.—Continued*

Occupancy or use	Area	Combustible contents		
		Mov- able prop- erty and trim	Floor	Total
Garnett annex, building 4				
Garnett annex.....	ft <sup>2</sup> 4,810	lb/ft <sup>2</sup> 5.4	lb/ft <sup>2</sup> 0.0	lb/ft <sup>2</sup> 5.4
Cotton warehouse, building 5				
Cotton warehouse.....	8,010	101.3	0.0	101.3
Shipping, building 6				
Shipping.....	15,640	20.7	0.0	20.7
Garnett parts stores				
Garnett parts stores.....	740	15.8	0.0	15.8

The difference found for the two plants was not great. Combustibles in amounts less than 10 lb/ft<sup>2</sup> were found in 48 percent of the area of one plant and in 66 percent of the area of the other, with the load uniformly distributed over areas as large as 7,310 ft<sup>2</sup>. The combustible loads within the range of 10 to 20 lb/ft<sup>2</sup> were 16.3 and 17.8 percent of the respective plant areas. Higher concentrations were largely in storage areas, with a baled-cotton-storage area having about 100 lb/ft<sup>2</sup>. The progress of fire in such baled materials is relatively slow.

TABLE 8b. *Survey data for mattress factory in Chicago, Ill.*

Occupancy or use	Area	Combustible contents		
		Mov- able prop- erty and trim	Floor	Total
Basement				
Storage.....	ft <sup>2</sup> 3, 881	lb/ft <sup>2</sup> 28.0	lb/ft <sup>2</sup> 0.0	lb/ft <sup>2</sup> 28.0
Do.....	1, 038	24.5	.0	24.5
Do.....	3, 144	19.0	.0	19.0
Storage and hair conditioning.....	2, 918	34.6	.0	34.6
Total.....	11, 001	---	---	---
Average.....	---	26. 8	0. 0	26. 8
First floor				
Shipping.....	3, 017	4. 5	2. 6	7. 1
Do.....	2, 495	6. 1	2. 6	8. 7
Do.....	4, 783	8. 4	2. 6	11. 0
Do.....	4, 745	9. 3	0. 0	9. 3
Shop machine repairs.....	1, 620	4. 1	. 0	4. 1
Garnetting.....	7, 063	3. 0	. 0	3. 0
Total.....	23, 723	---	---	---
Average.....	---	6. 0	1. 1	7. 1

TABLE 8b. *Survey data for mattress factory in Chicago, Ill.—Continued*

Occupancy or use	Area	Combustible contents		
		Mov- able prop- erty and trim	Floor	Total
Second floor				
Storage.....	ft <sup>2</sup> 3,804	lb/ft <sup>2</sup> 6.0	lb/ft <sup>2</sup> 2.6	lb/ft <sup>2</sup> 8.6
Do.....	3,234	7.9	2.6	10.5
Tufting and edging.....	7,310	3.7	2.6	6.3
Tufting and storage.....	6,174	2.6	2.6	5.2
Total.....	20,522	---	---	---
Average.....	-----	4.4	2.6	7.0
Third floor				
Storage—cloth.....	2,510	19.2	2.6	21.8
Cloth inspection.....	460	2.0	2.6	4.6
Cloth storage.....	2,598	22.7	2.6	25.3
Sewing.....	1,681	5.8	2.6	8.4
Do.....	2,593	4.9	2.6	7.5
Cutting cloth.....	4,355	3.8	2.6	6.4
Repairing machines.....	152	19.7	2.6	22.3
Office.....	135	8.4	2.6	11.0
Filling mattresses.....	6,100	7.3	2.6	9.9
Total.....	19,984	---	---	---
Average.....	-----	9.6	2.6	12.2
Fourth floor				
Boxing mattresses.....	1,860	13.8	2.6	16.4
Fifth floor				
Nailing box spring frames.....	235	9.9	2.6	12.5
Assembling box spring frames.....	1,271	9.1	2.6	11.7
Chair frames.....	460	9.5	2.6	12.1
Assembling bcds.....	648	18.5	2.6	21.1
Painting.....	1,222	3.9	2.6	6.5
Box spring frames.....	1,088	4.0	2.6	6.6
Storage.....	456	4.1	2.6	6.7
Do.....	2,376	5.5	2.6	8.1
Total.....	7,756	---	---	---
Average.....	-----	7.0	2.6	9.6

Table 8b shows that the higher concentrations were found in basement areas, the highest average for floors above the basement being 12.2 lb/ft<sup>2</sup>, with the highest concentration for an individual area on these floors being 25.3 lb/ft<sup>2</sup>.

TABLE 8c. *Percentage of mattress factory floor area having combustible contents within certain limits*

Range in combustible contents	Chicago (Total floor area, 84,846 ft <sup>2</sup> )		Atlanta (Total floor area, 72,805 ft <sup>2</sup> )	
	Part of total floor area	Largest single area within range	Part of total floor area	Largest single area within range
lb/ft <sup>2</sup>	Percent	ft <sup>2</sup>	Percent	ft <sup>2</sup>
0.0 to 4.9.....	10.8	7,063	7.9	1,124
5.0 to 9.9.....	55.2	7,310	40.6	4,810
10.0 to 14.9.....	11.9	4,783	3.7	990
15.0 to 19.9.....	5.9	3,144	10.6	6,170
20.0 to 29.9.....	12.8	3,881	22.1	13,640
30.0 to 49.9.....	3.4	2,918	---	---
50.0 to 69.9.....	---	---	2.1	1,536
Over 100.....	---	---	11.0	8,010

TABLE 9a. *Survey data for clothing factories*

Dress factory, Philadelphia, Pa.			Clothing factory, New York, N. Y.		
Occupancy or use	Area	Total <sup>a</sup> combustible contents	Occupancy or use	Area	Total <sup>a</sup> combustible contents
Second floor			First building, fifth floor		
	<i>ft<sup>2</sup></i>	<i>lb/ft<sup>2</sup></i>		<i>ft<sup>2</sup></i>	<i>lb/ft<sup>2</sup></i>
Women's dressing room.....	280	4.8	Pattern design.....	440	10.2
Hall.....	895	5.4	Offices.....	3,145	10.9
Men's room.....	115	6.0	Cutting.....	16,285	12.5
Designers office.....	1,650	6.8	Shrinkage and storage.....	4,275	13.4
Sample dress storage.....	160	6.8	Storage.....	7,085	19.6
Financial office.....	1,060	7.1	Total.....	31,230	-----
Storage and shipping.....	5,420	9.0	Average.....	-----	14.0
Front office.....	1,085	10.1			
Anteroom.....	75	10.6	First building, sixth floor		
Buttons, thread, etc., storage.....	515	17.8	Corridor.....	460	6.1
Cloth storage.....	850	34.7	Receiving and storage.....	5,005	9.8
Closet.....	60	36.3	Labels and assembly.....	1,680	11.0
Stationery storage.....	125	38.8	Suit storage.....	6,800	12.1
Total.....	12,290	-----	Packing.....	2,980	14.0
Average.....	-----	10.8	Total.....	16,925	-----
			Average.....	-----	11.5
Third floor			Second building, third floor		
Restroom and reserve area.....	2,410	4.1	Coatroom and storage.....	465	5.3
Women's dressing room.....	215	4.6	Hand sewing #3.....	1,215	5.7
Pressing, etc.....	2,915	4.9	Pressing #2.....	4,445	5.8
Sewing room.....	2,635	5.0	Hand sewing #1.....	1,350	6.9
Emergency restroom.....	145	5.7	Storage and receiving.....	1,400	7.9
Cutting.....	2,415	6.5	Pressing #1.....	840	8.1
Pattern design.....	700	7.4	Machine sewing #2.....	1,860	8.1
Office.....	195	8.2	Hand sewing #2.....	5,135	8.1
Machine repair.....	250	14.9	Machine sewing #1.....	1,476	8.5
Examination and inspection.....	490	16.0	Office.....	190	10.6
Pattern storage.....	80	29.9	Machine repair.....	115	13.1
Total.....	12,450	-----	Storage (cloth in bundles).....	315	22.1
Average.....	-----	6.1	Total.....	18,806	-----
			Average.....	-----	7.6

<sup>a</sup> Included in the total combustible content is 3 lb/ft<sup>2</sup> for flooring material.

TABLE 9b. *Percentage of clothing factory floor area having combustible contents within certain limits*

Range of combustible contents	New York, N. Y. (Total floor area, 66,961 ft <sup>2</sup> )		Philadelphia, Pa. (Total floor area, 24,740 ft <sup>2</sup> )	
	Part of total floor area	Largest single area within range	Part of total floor area	Largest single area within range
<i>lb./ft<sup>2</sup></i>	<i>Percent</i>	<i>ft<sup>2</sup></i>	<i>Percent</i>	<i>ft<sup>2</sup></i>
0.0 to 4.9.....	-----	-----	23.5	2,915
5.0 to 9.9.....	35.3	5,135	62.2	5,415
10.0 to 14.9.....	53.6	16,285	5.7	1,085
15.0 to 19.9.....	10.6	7,085	4.1	515
20.0 to 29.9.....	0.5	315	0.3	80
30.0 to 39.9.....	-----	-----	4.2	850

### c. Clothing Factories

The factory making women's clothing occupied the second and third floors of a building 100 by 142 ft in outside dimensions. The men's clothing factory covered the fifth floor and part of the sixth floor in one building and part of the third floor in another building. The premises surveyed contained all operations from the receiving of the original bolt of cloth to the shipping of the finished goods.

The more detailed data of the two surveys are given in table 9a, and the summary of results is given in table 9b.

In the establishment making women's dresses, over 85 percent of the floor area had combustibles of no more than 10 lb/ft<sup>2</sup>. For the men's clothing factory, about 90 percent of the floor area had combustibles in the range 5 to 15 lb/ft<sup>2</sup>. For both establishments, heavier loadings were confined largely to storage areas, aggregating an average of nearly 10 percent of the floor area for the two plants. In all areas of both factories there was wood flooring with a computed weight of 3 lb/ft<sup>2</sup>.

### 3.6. Printing Plants

Of the two establishments surveyed, the one doing job printing exclusively was in five connected buildings built at different times as the plant expanded. They had two or three stories and basement and were of reinforced-concrete construction with floors designed for live load of 250 lb/ft<sup>2</sup>.

The building for the newspaper plant, erected in 1922, had nine stories and basement, the in-



terior construction being protected structural steel. It housed the printing plant and newspaper offices.

A summary of results grouped by ranges in combustible load is given in table 10c, and the data for individual areas are given in tables 10a and 10b.

TABLE 10a. Survey data for printing plant in Washington, D. C.

Occupancy or use	Area	Combustible contents		
		Mov- able prop- erty and trim	Floor	Total
Basement				
	<i>ft</i> <sup>2</sup>	<i>lb/ft</i> <sup>2</sup>	<i>lb/ft</i> <sup>2</sup>	<i>lb/ft</i> <sup>2</sup>
Paper storage.....	2,145	77.8	----	77.8
Record file room.....	355	70.9	----	70.9
Dead storage.....	68	1.1	----	1.1
Oil storage.....	288	72.7	----	72.7
Miscellaneous parts.....	221	13.2	----	13.2
Commercial stock room.....	3,994	53.1	----	53.1
Paper storage.....	1,873	71.4	----	71.4
Miscellaneous storage.....	576	13.9	----	13.9
Maintenance shop.....	688	14.3	----	14.3
Paper storage.....	8,840	146.6	----	146.6
Do.....	9,700	167.2	----	167.2
Total.....	28,748	-----	----	-----
Average.....	-----	121.6	----	121.6
First floor				
Private office.....	384	11.8	4.1	15.9
Reception office.....	476	8.2	4.0	12.2
Shipping office.....	245	4.5	----	4.5
Commercial bindery.....	4,916	14.0	----	14.0
Do.....	4,712	14.6	----	14.6
Do.....	3,698	18.4	----	18.4
Sales office.....	454	11.0	4.0	15.0
Private office.....	240	8.6	4.0	12.6
Panel A.....	1,591	81.7	----	81.7
Panel B.....	1,924	14.7	----	14.7
Panel C.....	3,248	32.2	----	32.2
Panel D.....	549	28.8	----	28.8
Panel E.....	767	18.7	----	18.7
Commercial bindery.....	9,250	52.4	----	52.4
Total.....	32,454	-----	----	-----
Average.....	-----	30.8	0.2	31.0
Second floor				
Accounting office.....	747	8.1	1.0	9.1
Office.....	304	6.4	1.0	7.4
Pressroom.....	5,137	11.7	----	11.7
Do.....	4,834	29.4	----	29.4
Do.....	5,233	15.3	----	15.3
Production office.....	380	5.6	1.0	6.6
Panel A.....	3,200	40.0	----	40.0
Panel B.....	4,850	12.2	----	12.2
Pressroom office.....	438	11.3	4.0	15.3
Panel A.....	3,348	30.4	----	30.4
Panel B.....	5,624	14.5	----	14.5
Roller room.....	1,120	23.9	----	23.9
Total.....	35,215	-----	----	-----
Average.....	-----	19.7	0.1	19.8
Third floor				
Composing room.....	4,477	6.6	----	6.6
Monotype department.....	332	3.2	----	3.2
Composing room.....	2,650	4.9	----	4.9
Proofreading room.....	711	11.9	4.0	15.9
Type storage room.....	767	12.8	----	12.8
Job-press department.....	1,789	19.1	----	19.1
Total.....	10,726	-----	----	-----
Average.....	-----	8.9	0.3	9.2

TABLE 10b. Survey data for newspaper plant in Washington, D. C.

Occupancy or use	Area	Combustible contents			
		Mov- able prop- erty	Floor	Ex- posed wood- work other than floor	Total
Basement					
	<i>ft</i> <sup>2</sup>	<i>lb/ft</i> <sup>2</sup>	<i>lb/ft</i> <sup>2</sup>	<i>lb/ft</i> <sup>2</sup>	<i>lb/ft</i> <sup>2</sup>
Basement.....	11,740	35.2	---	---	35.2
Locker room.....	409	2.3	---	---	2.3
Storeroom.....	198	7.4	---	---	7.4
Total.....	12,347	---	---	---	---
Average.....	---	33.7	---	---	33.7
First floor					
Press room.....	3,870	1.6	1.0	---	2.6
Stereotype department.....	648	---	3.2	---	3.2
Office.....	127	9.8	---	0.8	10.6
Oil room.....	190	46.9	---	1.3	48.2
Machine room.....	426	10.7	5.0	---	15.7
Newsstand.....	228	8.1	2.6	5.0	15.7
Corridor.....	550	---	---	1.8	1.8
Total.....	6,039	---	---	---	---
Average.....	---	3.7	1.5	0.4	5.6
Mezzanine floor					
Delivery room.....	7,177	10.8	4.0	0.3	15.1
Offices.....	865	7.4	2.6	2.3	12.3
Corridor.....	292	13.1	4.0	2.2	19.3
Total.....	8,334	---	---	---	---
Average.....	---	10.5	3.9	0.5	14.9
Second floor					
Storeroom.....	764	56.8	2.6	0.2	59.6
Art department.....	511	5.5	6.6	1.6	13.7
Darkroom.....	149	3.8	---	3.0	6.8
Etching department.....	602	3.7	---	1.5	5.2
Offices.....	745	6.3	2.6	2.9	11.8
Office.....	154	8.9	2.6	5.9	17.4
Workroom.....	318	10.6	6.6	2.5	19.7
Storeroom.....	363	63.8	6.6	2.7	73.1
Service department.....	1,082	6.2	2.6	0.6	9.4
Machine room.....	2,549	2.9	2.5	.8	6.2
Corridor.....	470	---	---	2.5	2.5
Total.....	7,707	---	---	---	---
Average.....	---	12.4	2.8	1.4	16.6
Third floor					
Associated Press.....	3,880	4.1	3.6	1.2	8.9
Wirephoto department.....	1,260	6.0	3.6	2.8	12.4
Library.....	231	18.9	3.6	1.3	23.8
Offices.....	912	2.6	3.9	2.6	9.1
Storeroom.....	190	77.7	1.6	3.4	82.7
Do.....	154	44.9	2.6	2.8	50.3
Corridor.....	570	---	---	2.1	2.1
Total.....	7,197	---	---	---	---
Average.....	---	7.2	3.3	1.8	12.3
Fourth floor					
Storeroom.....	272	55.3	2.6	2.6	60.5
Darkroom.....	222	9.4	3.6	4.1	17.1
Storeroom.....	145	49.1	2.6	1.6	53.3
Workroom.....	434	24.1	2.6	1.6	28.3
Offices.....	502	7.8	6.6	2.0	16.4
Do.....	671	4.1	3.4	3.3	10.8
Do.....	276	2.3	2.6	4.1	9.0
Do.....	390	5.0	2.6	4.5	12.1
Do.....	639	8.9	2.6	2.3	13.8
Do.....	2,040	7.9	2.6	3.0	13.5
Corridor.....	1,577	---	---	3.2	3.2
Total.....	7,168	---	---	---	---
Average.....	---	9.3	2.4	2.9	14.6

TABLE 10b. *Survey data for newspaper plant in Washington, D. C.—Continued*

Occupancy or use	Area	Combustible contents			
		Mov- able prop- erty	Floor	Ex- posed wood- work other than floor	Total
Fifth floor					
Telephone switchboard and equipment.....	ft <sup>2</sup> 520	lb/ft <sup>2</sup> 1.8	lb/ft <sup>2</sup> 2.5	lb/ft <sup>2</sup> 2.3	lb/ft <sup>2</sup> 6.6
Storeroom.....	194	39.1	2.6	2.6	44.3
Offices.....	447	11.2	2.6	2.0	15.8
Do.....	1,290	10.3	2.6	3.4	16.3
Conference room, Board of Trade.....	1,294	1.1	2.6	1.0	4.7
Offices.....	2,041	5.4	3.0	3.0	11.4
Corridors.....	1,348	---	---	3.1	3.1
Total.....	7,134	---	---	---	---
Average.....	---	6.1	2.2	2.0	10.3
Sixth floor					
Offices.....	1,786	7.0	2.1	5.5	14.6
Corridor.....	740	2.8	---	3.1	5.9
Lobby.....	371	0.0	---	1.6	1.6
Office.....	324	4.8	3.6	5.1	13.5
Advertising and accounting.....	3,890	7.4	6.6	0.3	14.3
Total.....	7,111	---	---	---	---
Average.....	---	6.3	4.3	2.2	12.8
Seventh floor					
Office.....	1,900	6.3	2.6	4.0	12.9
Do.....	140	31.2	2.6	2.4	36.2
Art room.....	496	14.3	4.8	1.1	20.2
Photographers.....	439	6.2	---	2.1	8.3
Dental laboratory.....	126	10.0	2.6	1.2	13.8
City room.....	3,446	3.6	6.6	0.7	10.9
Corridor.....	692	0.1	---	3.5	3.6
Lobby.....	371	---	---	1.6	1.6
Total.....	7,610	---	---	---	---
Average.....	---	5.2	4.1	1.9	11.2
Eighth floor					
Stereotype room.....	1,296	0.7	3.2	0.5	4.4
Composing room.....	6,300	1.7	3.2	.3	5.2
Office.....	54	7.6	---	5.2	12.8
Lobby.....	176	---	3.2	1.6	4.8
Total.....	7,826	---	---	---	---
Average.....	---	1.5	3.2	0.4	5.1
Ninth floor					
Picture file room.....	914	13.2	3.2	0.4	16.8
Monotype room.....	390	0.9	3.2	1.0	5.1
Composing room A.....	1,600	1.5	3.2	0.1	4.8
Composing room B.....	990	0.9	3.2	1.5	5.6
Office.....	232	5.1	3.2	1.7	10.0
Storeroom.....	165	11.1	3.2	1.3	15.6
Office.....	54	2.5	3.2	5.1	10.8
Lobby.....	300	0.0	4.0	3.0	7.0
Locker room.....	1,494	1.0	0.2	---	1.2
Total.....	6,139	---	---	---	---
Average.....	---	4.2	1.6	0.6	6.4

For both buildings, combustibles of 10 to 20 lb/ft<sup>2</sup> covered about 40 percent of the floor area. A comparatively greater area in the newspaper plant had combustible contents of less than 10 lb/ft<sup>2</sup> because of the floor area occupied by equipment of incombustible type and the larger corridor areas. The higher loads in both plants were due to storage of paper before or after printing.

TABLE 10c. *Percentage of printing plant floor areas having combustible contents within certain limits*

Range of combustible contents	Printing plant (Total floor area, 107,143 ft <sup>2</sup> )		Newspaper plant (Total floor area, 84,612 ft <sup>2</sup> )	
	Part of total floor area	Largest single area within range	Part of total floor area	Largest single area within range
lb/ft <sup>2</sup>	Percent	ft <sup>2</sup>	Percent	ft <sup>2</sup>
0.0 to 4.9.....	3.1	2,650	21.0	3,870
5.0 to 9.9.....	5.5	4,477	21.7	6,300
10.0 to 14.9.....	28.1	5,624	24.9	3,446
15.0 to 19.9.....	12.5	5,233	14.3	7,177
20.0 to 29.9.....	6.1	4,834	1.4	496
30.0 to 39.9.....	6.2	3,348	14.0	11,740
40.0 to 49.9.....	3.0	3,200	0.5	194
50.0 to 59.9.....	12.4	9,250	1.2	764
60.0 to 79.9.....	4.3	2,145	0.8	363
80.0 to 100.0.....	1.5	1,591	.2	190
Over 100.....	17.3	9,700	---	---

### 3.7. Warehouses

The five warehouses surveyed were of protected-steel or reinforced-concrete construction and were from three to nine stories in height. Three of the buildings had basements. While five warehouses were surveyed, the more detailed survey data for only two, W-4 and W-5, are given in tables 11a and 11b. The percentage of the floor area, with combustible contents within a given range, and the largest single area over which the combustibles within these ranges were found for these two warehouses, are given in table 11c. Table 11d gives a complete summary of the combustible contents found in all five warehouses.

TABLE 11a. *Survey data for warehouse W-4 in Washington, D. C.*

Occupancy or use	Area	Combustible contents		
		Mov- able prop- erty	Exposed Wood- work other than floor	Total <sup>a</sup>
Basement				
Switchboard room.....	ft <sup>2</sup> 358	lb/ft <sup>2</sup> 2.0	lb/ft <sup>2</sup> 3.6	lb/ft <sup>2</sup> 5.6
Locker room.....	600	2.2	2.0	4.2
Basement storage.....	4,569	16.7	0.3	17.0
Total.....	5,527	---	---	---
Average.....	---	14.2	0.7	14.9
First floor				
Private office.....	192	5.8	7.4	13.2
General office.....	1,167	6.3	1.5	7.8
Vestibule.....	236	---	2.9	2.9
Sales office.....	653	7.6	3.0	10.6
Storage room A.....	95	15.8	---	15.8
Warehouse, panels A to G, inclu- sive.....	4,697	7.4	1.6	11.2
Total.....	7,040	---	---	---
Average.....	---	8.6	1.9	10.5

See footnote at end of table.

TABLE 11a. *Survey data for warehouse W-4, in Washington, D. C.—Continued*

Occupancy or use	Area	Combustible contents		
		Mov- able prop- erty	Exposed Wood- work other than floor	Total <sup>a</sup>
Second floor				
Warehouse, panels A-1, A-2, B, C, and D	ft <sup>2</sup> 8,916	lb/ft <sup>2</sup> 6.4	lb/ft <sup>2</sup> 0.5	lb/ft <sup>2</sup> 6.9
Total	8,916	6.4	0.5	6.9
Average				
Third floor				
Storeroom A	95	6.6	---	6.6
Warehouse, panels A to J, inclusive	8,599	24.5	0.5	25.0
Total	8,694	24.6	0.5	25.1
Average				
Fourth floor				
Storeroom A	95	41.1	---	41.1
Warehouse, panels A, B, and C	8,663	39.8	0.5	40.3
Total	8,758	39.8	0.5	40.3
Average				
Fifth floor				
Storeroom B	650	42.3	0.8	43.1
Warehouse, panels A and B	8,349	5.2	.4	8.0
Total	8,999	7.9	0.5	10.6
Average				

TABLE 11a. *Survey data for warehouse W-4 in Washington, D. C.—Continued*

Occupancy or use	Area	Combustible contents		
		Mov- able prop- erty	Exposed Wood- work other than floor	Total <sup>a</sup>
Sixth floor				
Storeroom A .....	<i>ft</i> <sup>2</sup> 95	<i>lb</i> / <i>ft</i> <sup>2</sup> 20.2	<i>lb</i> / <i>ft</i> <sup>2</sup> ---	<i>lb</i> / <i>ft</i> <sup>2</sup> 20.2
Storeroom B .....	255	31.7	1.0	35.3
Storeroom C .....	518	43.1	0.8	43.9
Warehouse, panels A, B, and C .....	8,437	13.0	.5	13.5
Total .....	9,305	15.3	0.5	15.9
Average .....	---	---	---	---
Seventh floor				
Storeroom A .....	95	70.7	---	70.7
Storeroom B .....	184	6.6	2.8	12.0
Storeroom C .....	589	11.7	0.9	12.6
Warehouse, panels A and B .....	8,437	27.0	.6	27.6
Total .....	9,305	26.1	0.6	26.8
Average .....	---	---	---	---
Eighth floor				
Storeroom A .....	95	18.8	---	18.8
Panel B .....	4,287	18.4	0.4	18.8
Panels A-1, A-2, C, and D .....	3,680	5.7	.4	6.1
Total .....	8,062	12.6	0.4	13.0
Average .....	---	---	---	---

<sup>a</sup>Where the total content is larger than the sum of the movable property and exposed woodwork, there was combustible flooring in that area that is included in the total.

TABLE 11b. *Percentage of floor area of warehouse W-5, New York, N. Y., having combustible contents within certain limits*

Range of combustible contents	Floor									
	Basement	First	Second	Third	Fourth	Fifth	Sixth	Seventh	Eighth	Ninth
0.0 to 9.9	Percent 5.2	Percent 29.2	Percent 10.5	Percent 7.6	Percent 3.3	Percent ---	Percent ---	Percent 13.5	Percent ---	Percent ---
10.0 to 19.9	7.4	14.8	3.8	6.7	3.3	---	3.3	3.4	7.0	---
20.0 to 29.9	---	25.6	3.3	17.0	13.5	3.4	3.3	---	---	---
30.0 to 39.9	15.2	6.7	6.7	3.4	14.4	---	10.4	---	6.8	17.2
40.0 to 49.9	14.9	6.8	15.6	3.4	20.4	14.9	21.4	---	18.3	10.1
50.0 to 74.9	44.3	10.1	29.5	29.7	29.2	39.6	29.1	23.7	26.1	40.3
75.0 to 99.9	9.3	6.8	20.4	6.7	8.0	25.2	25.6	10.1	24.9	20.3
100.0 to 149.9	3.7	---	6.8	22.1	11.2	6.7	6.9	18.3	3.4	4.5
150.0 to 199.9	---	---	3.4	---	---	10.2	---	28.7	---	7.6
200.0 to 256.6	---	---	---	3.4	---	---	---	15.8	---	---
Total area	10,806	11,848	11,848	11,848	11,848	11,848	11,848	11,848	11,848	11,848

The contents of warehouse W-1, for a large printing establishment, were largely stored paper in rolls, paper cartons, or wooden crates. The flooring over most of the area was either 2-in. asphalt paving blocks, assumed to have (in terms of wood) equivalent combustible weight of 6.2 lb/ft<sup>2</sup>, or 2½-in. end-grain hard pine blocks weighing 10 lb/ft<sup>2</sup>. Part of the area of the third floor (10,225 ft<sup>2</sup>) was depressed for railroad tracks on which there were 14 freight cars with paper contents aggregating 630,000 lb.

Warehouses W-2 and W-3 served department stores, with a large part of the storage consisting of clothing, furniture, floor coverings, paint, toys, wrapping paper, and cartons. The first floor of warehouse W-3 was used only for merchandise in transit and there was none on the floor at the time of the survey.

Warehouse W-4, near railroad terminals, carried incoming stocks of merchandise for local dealers. A percentage of the area, varying from floor to floor, was without load at the time of the survey.



TABLE 11c. *Percentage of storage-building floor areas having combustible contents within certain limits*

Range of combustible contents	Washington, W-4 (Total floor area, 74,606 ft <sup>2</sup> )		New York, W-5 (Total floor area, 117,170 ft <sup>2</sup> )	
	Part of total floor area	Largest single area within range	Part of total floor area	Largest single area within range
<i>lb/ft<sup>2</sup></i>	<i>Percent</i>	<i>ft<sup>2</sup></i>	<i>Percent</i>	<i>ft<sup>2</sup></i>
0.0 to 4.9.....	1.1	600	3.7	Survey units were floor bays with areas from 396 to 560 ft <sup>2</sup> .
5.0 to 9.9.....	30.3	8,916	2.9	
10.0 to 14.9.....	19.8	8,437	2.7	
15.0 to 19.9.....	12.1	4,569	2.2	
20.0 to 29.9.....	23.0	8,599	6.6	
30.0 to 39.9.....	0.3	255	8.0	
40.0 to 49.9.....	13.3	8,663	12.7	
50.0 to 59.9.....	---	---	---	
60.0 to 70.7.....	0.1	95	---	
50.0 to 74.9.....	---	---	30.2	
75.0 to 99.9.....	---	---	15.7	
100.0 to 149.9.....	---	---	8.3	
150.0 to 199.9.....	---	---	5.0	
200.0 to 256.6.....	---	---	2.0	

and the difference in the average load for the individual floors is as much attributable to this condition as to differences in concentrations for areas carrying load. Even for those floors carrying loads over nearly the whole area (4th, 5th, and 7th), a considerable range in average load was found.

Warehouse W-5 carried storage for a number of clients, and the types of goods stored covered a wide range. A plan of the sixth floor, which carried a load near the average for the warehouse, is shown in figure 3. The combustibles present were almost wholly in the goods stored and, hence, only the total combustibles represented thereby are given in table 11d for each floor. The average-load variation between floors, as also between panels on a floor, was large.

For warehouse W-4, about one-half of the floor area had combustible concentrations no higher than 15 lb/ft<sup>2</sup> and for almost all of the remaining area they were not over 50 lb/ft<sup>2</sup>. For warehouse W-5, nearly 18 percent of the floor area had combustible load of less than 30 lb/ft<sup>2</sup>, about 50 percent carried between 30 and 75 lb/ft<sup>2</sup>, 24 percent carried 75 to 150 lb/ft<sup>2</sup>, and 7 percent had greater combustible load.

### 3.8. Offices

The office surveys include areas in buildings that house offices, or spaces directly associated therewith, and office spaces found in the surveys of other occupancies. The survey data for all office areas is given in table 12a.

The range of combustibles found in offices in the various other occupancies, with the exception of the newspaper plant, was about the same as that of the offices, office and reception rooms, and office and light-file areas in buildings housing office occupancies. The former ranged from 4.5 to 15.9 lb/ft<sup>2</sup>, as compared to 3.8 to 16.7 lb/ft<sup>2</sup> for the latter. Law offices and law libraries gave

TABLE 11d. *Summary data for warehouses*

Portion of building	Floor area	Combustible contents			
		Movable property	Floor	Exposed wood-work other than floor	Total
Survey W-1					
	<i>ft<sup>2</sup></i>	<i>lb/ft<sup>2</sup></i>	<i>lb/ft<sup>2</sup></i>	<i>lb/ft<sup>2</sup></i>	<i>lb/ft<sup>2</sup></i>
Basement.....	33,890	172.9	6.2	0.0	179.1
1st floor.....	34,900	223.7	9.7	.0	233.4
2d floor.....	32,592	105.8	10.0	.4	116.2
3d floor.....	23,448	204.0	6.2	.0	210.2
3d floor.....	10,225	61.6	0.0	.0	61.6
3d-floor total.....	33,673	160.8	4.3	.0	165.1
Entire building.....	135,055	166.8	7.5	0.1	174.4
Survey W-2					
1st floor.....	46,158	6.8	0.0	0.0	6.8
2d floor.....	44,957	13.6	.0	1.0	14.6
3d floor.....	45,677	4.0	.0	1.2	5.2
4th floor.....	45,677	12.7	.0	2.2	14.9
5th floor.....	45,677	8.4	.0	1.9	10.3
6th floor.....	45,677	12.2	.0	3.8	16.0
Entire building.....	273,823	9.6	0.0	1.5	11.1
Survey W-3					
1st floor.....	17,442	0.0	0.0	0.0	0.0
2d floor.....	17,442	16.2	.0	.8	17.0
3d floor.....	17,442	16.0	.0	2.3	18.3
4th floor.....	17,442	10.6	.0	2.1	12.7
Entire building.....	<sup>a</sup> 52,326	14.3	0.0	1.7	16.0
Survey W-4					
Basement.....	5,527	14.2	0.0	0.7	14.9
1st floor.....	7,040	8.6	.0	1.9	10.5
2d floor.....	8,916	6.4	.0	0.5	6.9
3d floor.....	8,694	24.6	.0	.5	25.1
4th floor.....	8,758	39.8	.0	.5	40.3
5th floor.....	8,999	7.9	2.2	.5	10.6
6th floor.....	9,305	15.3	0.1	.5	15.9
7th floor.....	9,305	26.1	.1	.6	26.8
8th floor.....	8,062	12.6	.0	.4	13.0
Entire building.....	74,606	17.2	0.2	0.7	18.1
Survey W-5					
Basement.....	10,806	-----	-----	-----	50.0
1st floor.....	11,848	-----	-----	-----	27.8
2d floor.....	11,848	-----	-----	-----	62.5
3d floor.....	11,848	-----	-----	-----	65.9
4th floor.....	11,848	-----	-----	-----	54.0
5th floor.....	11,848	-----	-----	-----	80.6
6th floor.....	11,848	-----	-----	-----	62.2
7th floor.....	11,848	-----	-----	-----	133.3
8th floor.....	11,848	-----	-----	-----	52.9
9th floor.....	11,848	-----	-----	-----	70.3
Entire building.....	117,438	-----	-----	-----	65.9

\* Not including the first floor, which was used only for merchandise in transit.

loads in the range 17.9 to 35.3 lb/ft<sup>2</sup>. For heavy filing, the range was from 28.1 to 85.9 lb/ft<sup>2</sup>.

In table 12b are given the total area, percent of total area, and largest single area, having combustible load within given ranges. It is seen that a little less than 70 percent of the total office area surveyed had combustible load of less than 20 lb/ft<sup>2</sup>, about 28 percent had 20 to 40 lb/ft<sup>2</sup>, and in only a relatively small part was the load over 40 lb/ft<sup>2</sup>.

TABLE 12a. Survey data of offices and offices associated with other occupancies

Occupancy or use	Number of offices surveyed	Total floor area	Average combustible contents				
			Moveable property and trim	Floor	Total		
					Average	Maximum	Minimum
Office building:		ft <sup>2</sup>	lb/ft <sup>2</sup>	lb/ft <sup>2</sup>	lb/ft <sup>2</sup>	lb/ft <sup>2</sup>	lb/ft <sup>2</sup>
Office only.....	2	407	5.9	2.3	8.2	8.8	7.0
Office and reception room.....	2	581	4.9	1.7	6.6	8.8	4.3
Office and light files.....	20	11,860	8.0	0.8	8.8	16.7	3.8
Heavy files.....	9	27,431	35.7	.2	35.9	85.9	28.1
Law office.....	2	556	18.5	---	18.5	19.6	17.9
Law library.....	2	2,992	17.2	0.1	17.3	35.3	19.7
Offices in:							
Department stores.....	2	11,230	5.9	.7	6.6	6.9	6.4
Furniture factories.....	3	1,534	7.1	4.1	11.2	11.6	9.7
Printing plant.....	9	3,668	8.6	2.6	11.2	15.9	4.5
Newspaper plant.....	22	19,479	9.7	3.5	13.2	36.2	8.9
Dress factory.....	4	3,990	4.8	3.0	7.8	10.1	6.8
Men's clothing factory.....	2	3,335	7.9	3.0	10.9	10.9	10.6
Warehouse.....	3	2,012	10.5	---	10.5	13.2	7.8

TABLE 12b. Percentage of the floor areas of offices and offices associated with other occupancies having combustible contents within certain limits

Range of combustible contents	Area within range	Total area within range	Largest single area within range
	ft <sup>2</sup>	Percent	ft <sup>2</sup>
0.0 to 9.9.....	27,242	31.0	7,230
10.0 to 14.9.....	24,844	28.2	3,890
15.0 to 19.9.....	7,961	9.0	2,533
20.0 to 29.9.....	9,031	10.2	7,742
30.0 to 39.9.....	15,877	18.0	9,550
40.0 to 85.9.....	3,122	3.6	2,041

4. General Notes and Summary

The results of the surveys show that there is a correlation between some of the occupancies and combustible loading. In other occupancies, such as manufacturing and storage, there is much variation, depending on the classes of materials involved and the operational plans of the establishments.

In large areas within fire walls or fire partitions, the fire exposure to the floor construction above from a fire in the contents would vary to an extent with the concentrations of combustibles on the floor beneath.

**4.1. Residential Occupancies**

Combustible loadings of 13 to 14 lb/ft<sup>2</sup> were found in limited areas in dwellings and a concentration of 49.3 lb/ft<sup>2</sup> was found in a linen closet. However, the greatest average for a whole dwelling unit did not exceed 10 lb/ft<sup>2</sup>, and in view of the fact that there were no subdividing fire walls, the average combustible load (10 lb/ft<sup>2</sup>) appears to be a reasonable value. The six apartment-house storage rooms, at the time surveyed, had

no greater combustible load than the highest average for dwelling units as a whole.

4.2. Hospitals

Three buildings, each housing a different hospital activity, were surveyed at a large institution. A total of 469 rooms or units having an aggregate area of 143,780 ft<sup>2</sup> was surveyed.

The group averages of combustible contents for patients' rooms, dormitories, waiting rooms, corridors, kitchens, and dining rooms ranged from 0.8 to 3.9 lb/ft<sup>2</sup>, with no single area or unit exceeding 5.2 lb/ft<sup>2</sup>. The range of the group averages for administrative, doctors', attendants', and nurses' offices and rooms was from 2.9 to 8.6 lb/ft<sup>2</sup>, with a maximum for an individual area of 14.4 lb/ft<sup>2</sup>. In service areas, including storerooms, laundries, and janitors' closets, the averages ranged from 0.5 to 13.1 lb/ft<sup>2</sup>, with an individual maximum of 23 lb/ft<sup>2</sup>. Loadings in the range of 0.2 to 21.6 lb/ft<sup>2</sup> were found in individual areas used for treatment, surgery, and clinics.

The lower combustible loads were found in the comparatively large ward, dormitory, and patient-room areas rather than in office, service, and operational areas.

4.3. Schools

The surveys indicate that in classrooms, laboratories, library reading rooms, and similar areas the combustible contents did not exceed 15 lb/ft<sup>2</sup>. Library stackrooms, storerooms, and offices, representing a small percentage of the total area, had higher combustible loads.

4.4. Mercantile Establishments

Combustible loads below 20 lb/ft<sup>2</sup> were found in all but 3.8 percent of the area surveyed in the New York department store, and in all but 5.0 percent of the area in the Washington department store. The higher combustible loads were, generally, from sales stocks and stock storage not effectively segregated from the other areas. In view of the large open areas and the small proportion containing the higher combustible loads, it appears that the effect of these loads on the general fire severity would be minor.

4.5. Manufacturing Establishments

The range of combustible contents in manufacturing plants is large, depending to a great extent on the goods made. The results of the present surveys should be helpful in giving information on the combustible loads to be expected in the types of plants surveyed or in those that are similar.

The buildings housing the higher combustible loads were seldom of heights or areas requiring so-called "fully fire-resistive" construction, although such construction might be justified from



the standpoint of the owner and the decrease in hazard to nearby property.

The combustible contents in the clothing factories surveyed were less than 20 lb/ft<sup>2</sup> for all but a small percentage of the area. Such occupancy does not represent an excessive potential fire severity for buildings of fire-resistive construction.

#### 4.6. Printing Establishments

The newspaper plant surveyed contained a combustible load of 30 lb/ft<sup>2</sup> or over on only 16.7 percent of the area. The printing plant carried a combustible load of 30 lb/ft<sup>2</sup> or more on 44.7 percent of the floor area. The higher load in each case was caused by storage of paper and combustible supplies.

#### 4.7. Warehouses

The contents of storage buildings surveyed covered a wide range in type and distribution of the combustible materials housed.

For the two department store warehouses and the one carrying incoming stocks for local dealers, the combustible loads were within the range where structural protection for the possible fire severity can be provided without resort to unusual building details.

The high combustible loads in the warehouse for a big printing establishment were largely of paper in tight rolls or packages. After the initial stage of a fire in such contents, the intensity decreases, allowing more ready approach for extinguishment. In the absence of extinguishment, such storages will be fully consumed, and the required structural protection against the resulting fire severity is beyond presently defined means of attainment.

The general-storage warehouse, W-5, carried combustible loads up to 75 lb/ft<sup>2</sup> on nearly 70 percent of its area. Combustibles on the remaining area ranged up to 256.5 lb/ft<sup>2</sup> for an individual floor bay and to 133.3 lb/ft<sup>2</sup> for an entire floor. Combustible loads below 30 lb/ft<sup>2</sup> occupied only 18.1 percent of the building, and only 1 floor of the 10 had such a low average.

#### 4.8. Office Occupancies

No surveys were made covering all parts of office buildings; however, surveys were made of typical areas in six such buildings, and of office areas in a number of other occupancies. In office areas, including light files, the combustibles exceeded 20 lb/ft<sup>2</sup> only in a small office of the newspaper plant where it amounted to 36.2

lb/ft<sup>2</sup> on an area of 140 ft<sup>2</sup>. The fire severity resulting from this concentration would be reduced by the lower combustible load in large adjacent areas averaging less than 15 lb/ft<sup>2</sup>.

In areas used for heavy files, the combustible contents ranged from 28.1 to 85.9 lb/ft<sup>2</sup>. In law libraries, combustible loads as high as 35.3 lb/ft<sup>2</sup> were found.

### 5. General Objective and Application

The data from the present surveys present a general view of the combustible contents associated with typical buildings and occupancies. In conjunction with information from fire-severity tests and fires in buildings, data from these surveys can be applied in connection with requirements for minimum fire resistance of buildings, such as in building codes. Beyond such minimum requirements, building designers and owners can apply the data to provide a degree of structural protection that will prevent collapse of the structure from fires in contents. Where such structural protection cannot be fully attained, it can be supplemented with built-in fire-extinguishing equipment.

Although buildings may be seriously damaged by a fire of severity approaching that for which their structural protection is designed, prevention of major collapse is important in decreasing the possibility of spread of fire to adjacent construction and in affording a safer approach for fire extinguishment. Conflagrations have been stopped on a line of such fire-resistive buildings and, although fire was communicated to those immediately exposed, such buildings gave the needed protection to buildings beyond them.

### 6. References

- [1] Fire-resistance classifications of building constructions, NBS Building Materials and Structures Report (1942), BMS92.
- [2] S. H. Ingberg, The severity of building fires, Proc. 14th Annual Meeting Building Officials Conference of America, 87-97 (1928); Safety Eng. **56**, 57-61 and 103-106 (1928); Quart. Nat. Fire Protect. Assoc. **22**, 43-61 (1928); Arch. Forum **50**, 775 (1929).
- [3] Standard methods of fire tests of building construction and materials, American Society for Testing Materials, Designation E119-54.
- [4] Post war building studies No. 20 (1946), Fire grading of buildings, part 1, General principles and structural precautions, by a Joint Committee of the Building Research Board of the Department of Scientific and Industrial Research and the Fire Offices Committee; published for the Ministry of Public Works, H. M. Stationery Office, London.
- [5] International Critical Tables **5**, 162-169 (1929).
- [6] Handbook of fire protection of the National Fire Protection Association, 11th Ed., 1460-1461 (1954).



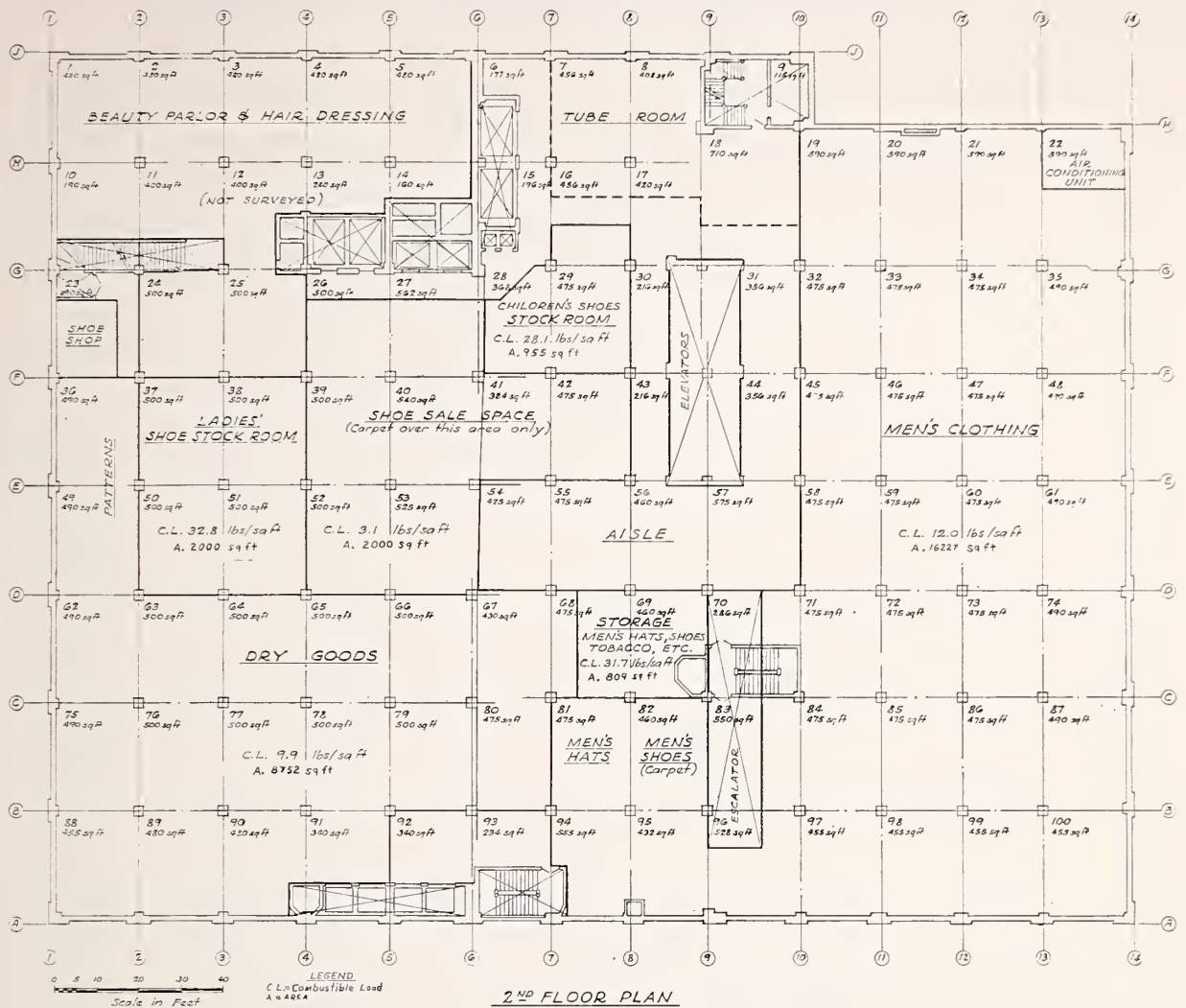
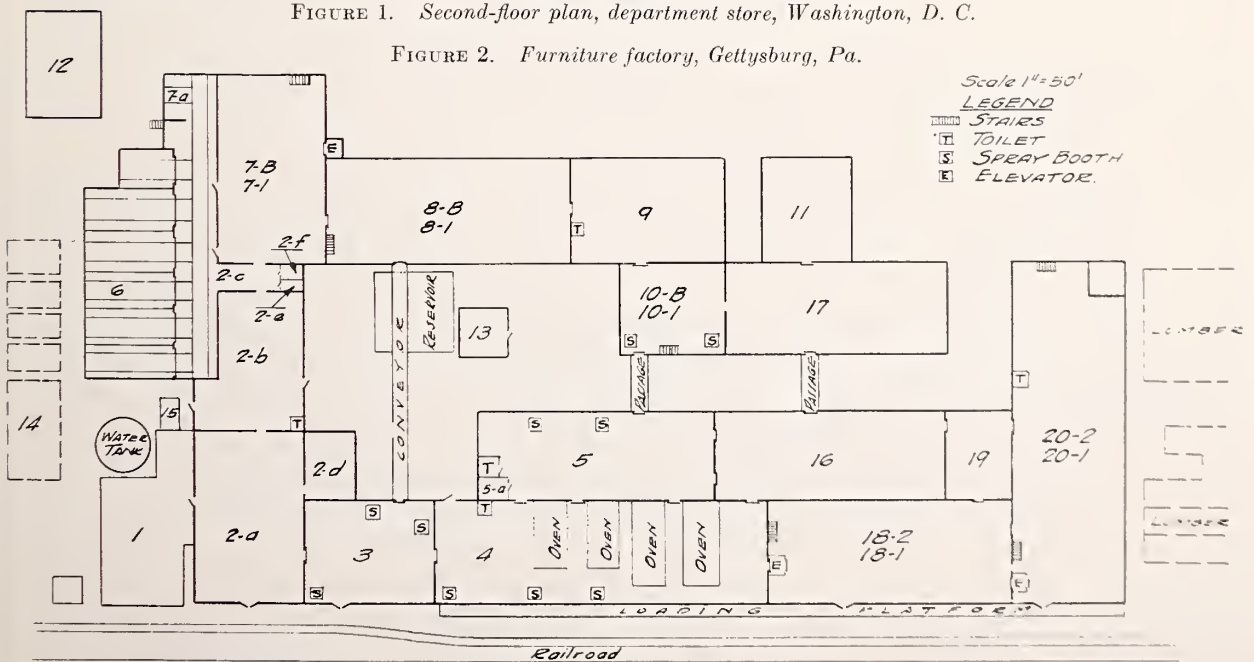


FIGURE 1. Second-floor plan, department store, Washington, D. C.

FIGURE 2. Furniture factory, Gettysburg, Pa.



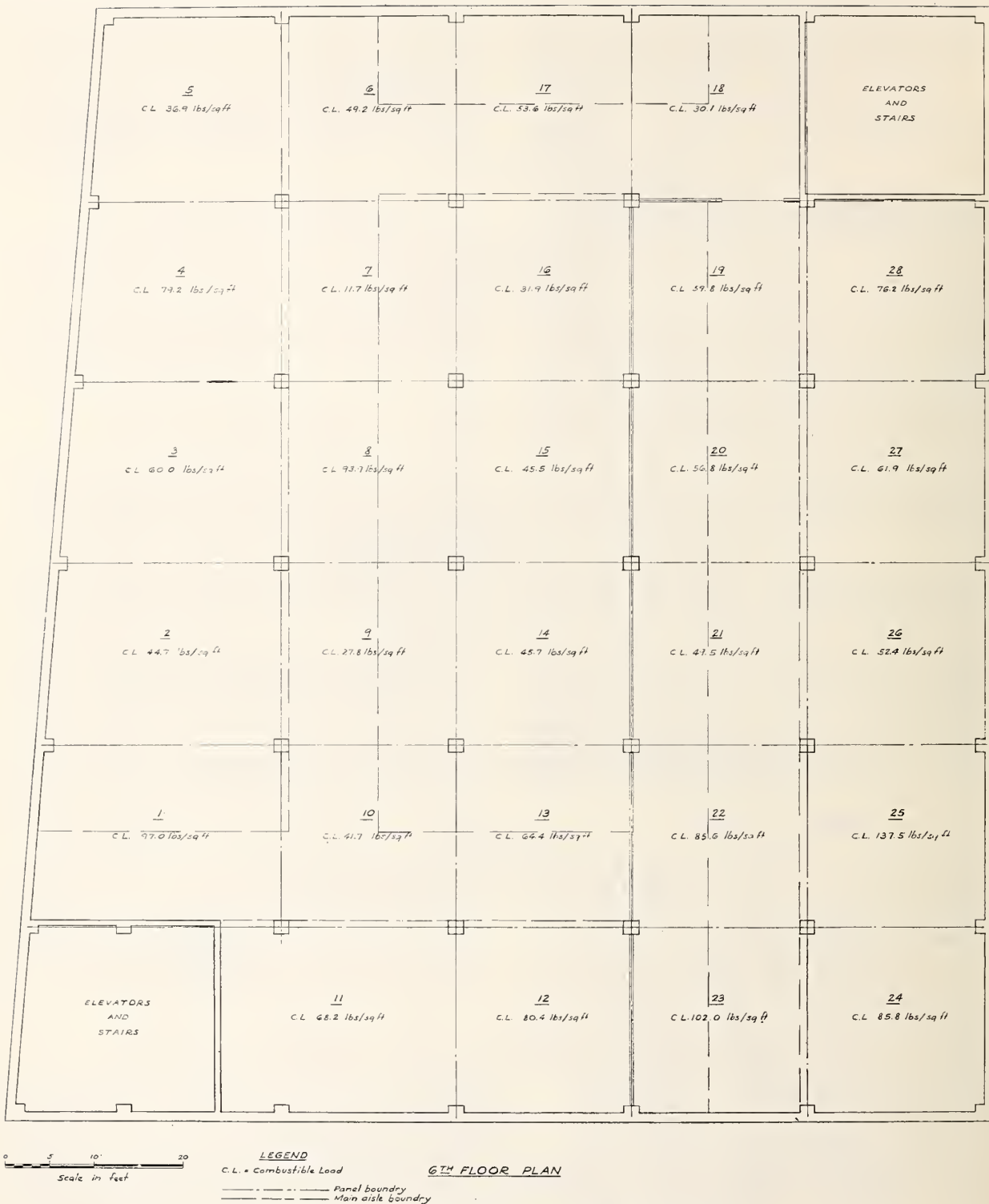


FIGURE 3. Sixth-floor plan, warehouse, New York, N. Y.

WASHINGTON, December 5, 1956.

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